WE CLAIM:

1. A position measuring system, comprising:

a scale comprising:

an incremental graduation track of a defined incremental graduation period; and

on at least one defined reference position, a reference marking field with a mean reference marking graduation period, wherein said mean reference marking graduation period differs from said incremental graduation period;

a scanning unit movable with respect to said scale, said scanning unit comprising a plurality of scanning elements for generating scanning signals, wherein at least two phase-shifted incremental signals are generated as scanning signals;

a first evaluation device arranged downstream of said scanning unit that determines a rough reference position from a maximum of resultant disturbance with said scanning signals at a defined relative position of said scale and said scanning unit;

a second evaluation device arranged downstream of said scanning unit that determines a beat signal phase from a difference between a whole-number multiple of a reference pulse signal phase and a whole-number multiple of an incremental signal phase; and

a third evaluation device arranged downstream of said first and second evaluation devices, which is suitable for unequivocally marking a beat signal period from said rough reference position and, if a defined phase position exists, to issue a fine reference position from said beat signal phase.

2. The position measuring system in accordance with claim 1, wherein said scale and said scanning unit are embodied in such a way, that only two or more phase-shifted incremental signals, which show a disturbance at said reference position, result as scanning signals.

3. The position measuring system in accordance with claim 2, further comprising a filter arranged upstream of said first evaluation device, to which said incremental signals are conducted and by which an elimination of a frequency portion of said incremental signals from said scanning signals takes place.

4. The position measuring system in accordance with claim 3, wherein said filter is a band pass filter, which provides a blockage in said range of said incremental signal frequency.

5. The position measuring system in accordance with claim 3, wherein said first evaluation device comprise a maximum detector that determines an amplitude maximum of a signal at an output of said filter, so that a signal regarding a rough reference position is present at an output of said first evaluation device.

6. The position measuring system in accordance with claim 1, wherein said second evaluation device comprises:

two multiplication units, through which multiplication of input signals regarding said reference pulse signal phase and said incremental signal phase by whole number factors takes place; and

a difference-forming unit, to which output signals from said multiplication units are supplied.

7. The position measuring system in accordance with claim 1, wherein said third evaluation device comprises:

a difference-forming unit, by which a subtraction of a fixed, selectable nominal phase value from said beat signal phase takes place; and

a selection device through which a particular crossover of the beat signal phase difference is determined which lies within a same beat period as said rough reference position, so that a crossover selected in this way is output as a signal regarding said fine reference position.

8. The position measuring system in accordance with claim 7, further comprising a memory arranged downstream of said third evaluation device that provides an incremental counter offset and which, if there is a fine reference position present, stores said actual incremental position.

9. The position measuring system in accordance with claim 8, wherein an output outputs said incremental counter offset.

10. The position measuring system in accordance with claim 8, further comprising a subtractor that subtracts said incremental counter offset from said incremental position.

11. The position measuring system in accordance with claim 1, wherein said reference marking field on said scale is integrated into said incremental graduation track.

12. The position measuring system in accordance with claim 1, wherein said reference marking field comprises a graduation structure of such a kind that, besides said reference marking graduation period, said incremental graduation period is also contained in it, so that at least two different spatial deflection directions for incoming beams result in an area of said reference marking field.

13. The position measuring system in accordance with claim 1, wherein a spectrum of a plurality of reference marking graduation periods is contained in said reference marking field, which are distributed around said mean reference marking graduation period.

14. The position measuring system in accordance with claim 13, wherein in said reference marking field a ratio of said frequency width to said mean reference marking graduation period is in the range from approximately 0.001 to approximately 0.5.

15. The position measuring system in accordance with claim 1, wherein said mean reference marking graduation period slightly differs from double said incremental graduation period.

16. The position measuring system in accordance with claim 11, wherein said scale is a reflection phase grating.

17. The position measuring system in accordance with claim 1, wherein said scanning unit comprises:

a light source; and

a scanning plate comprising a scanning graduation and an opto-electronic detector array.

18. The position measuring system in accordance with claim 12, wherein said scanning graduation has a graduation structure of such a type that partial beams arriving from a direction of said reference marking field in different deflection directions again undergo a deflection in a direction toward said reference marking field on said scale.

19. The position measuring system in accordance with claim 17, wherein said scanning graduation has a graduation structure of such a type that partial beams arriving from a direction of said reference marking field in different deflection

directions again undergo a deflection in a direction toward said reference marking field on said scale.

20. The position measuring system in accordance with claim 12, wherein said scanning plate comprises spatially separated partial areas of scanning graduations with incremental scanning gratings and reference scanning gratings.

21. The position measuring system in accordance with claim 17, wherein said scanning plate comprises spatially separated partial areas of scanning graduations with incremental scanning gratings and reference scanning gratings.

22. The position measuring system in accordance with claim 12, wherein said scanning plate has only a single scanning graduation, which causes deflection of beams arriving from different directions toward said reference marking field on said scale.

23. The position measuring system in accordance with claim 17, wherein said scanning plate has only a single scanning graduation, which causes deflection of beams arriving from different directions toward said reference marking field on said scale.

24. The position measuring system in accordance with claim 13, wherein said scanning plate comprises a scanning graduation with a spectrum of

scanning graduation periods which is matched to a spectrum of several reference marking graduation periods on said scale.

25. The position measuring system in accordance with claim 17, wherein said scanning plate comprises a scanning graduation with a spectrum of scanning graduation periods which is matched to a spectrum of several reference marking graduation periods on said scale.

26. The position measuring system in accordance with claim 24, wherein said reference marking field and said scanning graduations are each embodied as chirped graduation
structures, within which the graduation periods are evenly and continuously changed.

27. The position measuring system in accordance with claim 25, wherein said reference marking field and said scanning graduations are each embodied as chirped graduation structures, within which the graduation periods are evenly and continuously changed.

28. The position measuring system in accordance with claim 17, wherein a size of said reference marking field corresponds to a size of a cross section of a beam emitted by said light source.

29. The position measuring system in accordance with claim 17, wherein said scanning plate is an incident light phase grating.

30. The position measuring system in accordance with claim 17, wherein said scanning unit comprises a deflection prism and;

wherein said scanning unit has a structure such that:

a) beams emitted by said light source first impinge on said scale, where a diffraction back in a direction of said scanning unit takes place;

b) back-diffracted beams pass a first time through said scanning plate in said scanning unit and are propagated in a direction toward said deflection prism;

c) said deflection prism causes a deflection in a direction toward said scanning plate takes place, through which a second passage takes place; and

d) said beams impinge a second time on said scale, which provides a diffraction in a direction of said detector array.